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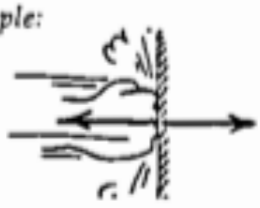
Forces & Motion WS 5 "Newton's 3rd Law"

1. In the example below, the action - reaction pair is shown by the arrows and the action - reaction described in words. In (a) through (g) draw the other arrow and state the reaction to the given action. Make up your own example in (h).

Example:



Fist hits wall.

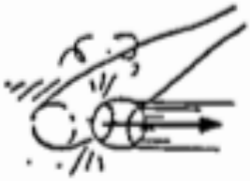
Wall hits fist.

Head bumps ball.

(a) _____

Windshield hits bug.

(b) _____



Bat hits ball.

(c) _____

Hand touches nose.

(d) _____

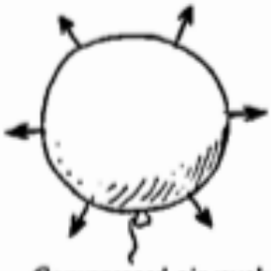
Hand pulls on flower.

(e) _____

Athlete pushes bar upward.

(f) _____

_____



Compressed air pushes balloon surface outward.

(g) _____

_____

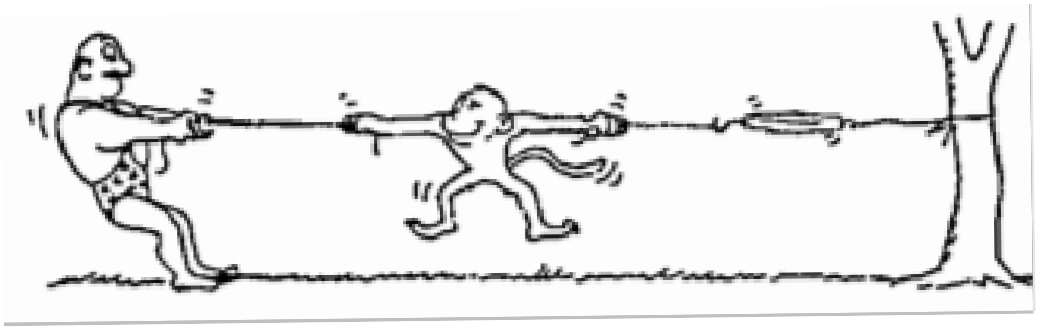
(h) _____

_____

_____

_____

2. Draw arrows to show the chain of at least six pairs of action - reaction forces below



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For question 3 refer to the image to the right. For (a) - (f) circle the correct phrase that completes the statement.

3. Nellie holds an apple with a weight of 1.0 N at rest on the palm of her hand. The force vector shown are the forces that act on the apple.

   a. To say the weight of the apple is 1.0 N is to say that a downward gravitational force of 1.0 N is exerted on the apple by
      (the earth) (her hand).

   b. Nellie's hand supports the apple with a force "n" which acts in a direction opposite to W. We can say "n"
      (equals W) (has the magnitude as W)

   c. Since the apple is at rest, the net force on the apple is
      (zero) (nonzero).

   d. Since "n" is equal and opposite to W, we (can) (cannot) say that "n" and W comprise an action reaction pair. The reason is because action and reaction always…
      (act on the same object) (act on different objects),

      and here we see n and w
      (both acting on the apple) (acting on different objects).

   e. In accord with the rule, "if action is A acting on B, then reaction is B acting on A," if we say action is the earth pulling down on the apple. Reaction is
      (the apple pulling up on the earth) (n, Nellie's hand pushing up on the apple).

   f. To repeat for emphasis, we see that n and W are equal and opposite to each other
      (and comprise an action - reaction pair) (but do not comprise an action - reaction pair).

4. While driving, Anna Litical observed a bug striking the windshield of her car. Consider one force to be the bug hittin the windshield.
   a. What is the Newton's Third Law pair to this force? b. Which of the two forces is greater?

5. A gun recoils when it is fired. As the gases from the gunpowder explosion expand, the gun pushes the bullet forward and the bullet pushes the gun backwards.

How do these two forces compare?	The acceleration of the recoiling gun is
a. The force of the gun on the bullet is larger. b. The force of the bullet on the gun is larger. c. The forces are the same.	a. Greater than the acceleration of the bullet. b. Smaller than the acceleration of the bullet. c. The same size as the acceleration of the bullet.

How do you know?

6. A high school student hits a nail with a hammer. During the collision, there is a force

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a. On the hammer but not on the nail.
b. On the nail but not on the hammer.
c. On the nail and also on the hammer.

7. A woman weighing 500 *N* sits on the floor.

She exerts a force on the floor of	The floor exerts a force on her of
a. 5 *N*. b. 50 *N*. c. 250 *N*. d. 500 *N*. e. 1000 *N*.	a. 5 *N*. b. 50 *N*. c. 250 *N*. d. 500 *N*. e. 1000 *N*.

8. A person is attracted towards the center of the earth by an 800 *N* gravitational force. The force with which the earth is attracted toward the person is
   a. Very very small.
   b. Very very large.
   c. 800 N.

9. An unfortunate bug splatters against your face as you run the 100 *meter* dash. Compared to the force of your face on the bug, the force of the bug on your face is
   a. Larger.
   b. Smaller.
   c. The same.
   d. Need more information to say

10. An unfortunate bug splatters against your face as you run the 100 *meter* dash. Compared to the acceleration of your face, the acceleration of the bug is
   a. Larger.
   b. Smaller.
   c. The same.
   How do you know?

11. A Mack truck and a Volkswagen Bug traveling at the same speed have a head-on collision. The vehicle to undergo the greater change in velocity will be the
   a. Volkswagen.
   b. Mack truck.
   c. Both the same

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13. A bottle sits on the ground as in the diagram above. Draw a separate force diagram for the bottle and for the Earth on the diagram to the right. Remember, the length of a force arrow represents the magnitude of the force. Use the following interaction notation.
    - $F_{g,Eb}$ = force of gravity of the Earth pulling down on the bottle.
    - $F_{g,bE}$ = force of gravity of the bottle pulling up on the Earth.
    - $F_{N,Eb}$ = force of the Earth's surface supporting the bottle.
    - $F_{N,bE}$ = force of the bottle pushing down on the Earth's surface.

Earth

Compare the magnitude and direction of $F_{g,Eb}$ with the magnitude and direction of $F_{g,bE}$. How do you know?	Compare the magnitude and direction of $F_{N,Eb}$ with the magnitude and direction of $F_{N,bE}$. How do you know?
Compare the magnitude of $F_{g,Eb}$ with the magnitude of $F_{N,Eb}$. How do you know?	Compare the magnitude of $F_{g,bE}$ with the magnitude of $F_{N,bE}$. How do you know?

14. A 70 *kg* Mother and her 35 *kg* son are standing at rest on an ice rink, as shown above. They push against each other, causing them to glide apart. Assume friction is negligible. Draw a separate force diagram for the woman and for her son as they push each other apart. Remember, the length of a force arrow represents the magnitude of the force. Use the following interaction notation.
    - F_{MS} = force of the mother pushing on her son
    - F_{SM} = force of the son pushing on his mother

Compare the magnitude and direction of F_{MS} with the magnitude and direction of F_{SM}. How do you know?	Given your answer to (a), who is moving faster after they separate? How do you know?

Compare the magnitude of the force of gravity acting on the Mother $F_{g,M}$ and the magnitude of the force of gravity acting on the son $F_{g,S}$. How do you know?